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Original Article

Identification of assistive technologies in paralympic sports: contributions and barriers[1]

Identificação das tecnologias assistivas no esporte paralímpico: contribuições e barreiras

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Abstract

The Paralympic sport is the sport modalities that make up the Paralympic Games, applying adapted rules, specifics theories, and structures for people with disabilities. The objective of this research was to present the assistive technologies (AT) used by para-athletes, their satisfaction with AT devices and the services provided and, identify the main requirements for the good use of each AT and services, correlating barriers and facilitators for the practical of para-sports. The exploratory descriptive research consisted of 54 para-athletes with physical and sensory disabilities, who answered the Assistive Technology Device Predisposition Assessment (ATD PA-Br) and Quebec User Evaluation of Satisfaction with Assistive Technology QUEST B. Seven different AT were cited and analyzed singly: manual wheelchairs, prosthesis, bracing, arm strap, insole, ball, and racket adapted. Among the items considered fundamental for the good use of the device, the safety, the comfort, and effectiveness were cited in all AT devices. The most cited device was the wheelchair, 43% of the para-athletes were very satisfied with the device and 54% dissatisfied with the service provided to the AT. This study can identify some assistive technologies devices used in Paralympic sport and it is concluded that the items considered important to the use of AT, as well as user satisfaction and assistance provided, can either act as barriers or facilitators to the practice of parasport. It is noteworthy that there are still few studies that focus on assistive technologies and Paralympic sport.

Keywords: Occupational Therapy, Self-Help Devices, Disabled Persons, Sports Medicine, Social Participation.

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Resumo

O esporte paralímpico diz respeito às modalidades de esportes que compõem os jogos paralímpicos, tendo adaptação nas regras, nos fundamentos e nas estruturas, tornando-se específicos para as pessoas com deficiências. O objetivo desta pesquisa foi apresentar as Tecnologias Assistivas (TA) utilizadas pelos paratletas, sua satisfação com estas e com o serviço prestado, além de identificar os principais quesitos para o bom uso de cada TA, relacionando barreiras e facilitadores para a prática do paraesporte. A pesquisa descritiva exploratória contou com 54 paratletas com deficiência física e sensorial, que responderam às Avaliação de Tecnologia Assistiva (ATD PA Br) e a Avaliação da Satisfação do Usuário com a Tecnologia Assistiva de Quebec QUEST B. Foram identificadas sete diferentes TA, as quais foram analisadas separadamente: cadeira de rodas manual, prótese, órtese, faixa para braço, palmilha, bola e raquete adaptadas. Dentre os itens considerados fundamentais para o bom uso do dispositivo, a segurança, o conforto e a eficácia foram citados em todas as TA. O dispositivo mais citado foi a cadeira de rodas: 43% dos paratletas se mostraram bastante satisfeitos com o dispositivo, e 54% insatisfeitos com o serviço prestado pela TA. Este estudo pôde identificar algumas Tecnologias Assistivas utilizadas no esporte paralímpico; concluiu-se que os itens considerados fundamentais ao uso da TA, assim como a satisfação do usuário e a assistência prestada, podem atuar como barreiras ou facilitadores à prática do paraesporte. Destaca-se que ainda são escassos os estudos que focam as Tecnologias Assistivas e o esporte paralímpico.

Palavras-chave: Terapia Ocupacional, Equipamentos de Autoajuda, Pessoas com Deficiência, Medicina Esportiva, Participação Social.

1 Introduction

Even with the advances in recent decades related to public policies and the reconfiguration of disabled people's associations, there are still segregation actions for disability (Corrales & Castro, 2016). According to the Statute for People with Disabilities (Brasil, 2015b), they have the right to culture, sport, tourism, and leisure equally than other people, with access to all these spaces being guaranteed. The Public Power must have the incentive, which should also promote the participation of people with disabilities in artistic, intellectual, cultural, sports, and recreational activities.

The first registration in Brazil of the sport for people with disabilities was in 1958, developing adapted sports together with the founding of two clubs: the *Clube dos Paraplégicos de São Paulo*, created by Sérgio Serafim Del Grande, and the Clube do Otimismo do Rio de Janeiro, created by Robson Sampaio de Almeida (Costa & Souza, 2004).

The name of *adapted sports* commonly used in Brazil consists of the possibility of practice for people with disabilities, having adaptation in the rules, foundations, and structures so that these people can practice this activity. In other languages, the most used phrase is Sport for persons with a disability. The term Paralympic Sport or para-sport defines the adapted modalities that are part of the Paralympic Games (Silva et al., 2013). Silva et al. (2013) cited three factors related to the growth of adapted and Paralympic

sports: the effectiveness of the sport in the rehabilitation process; the right of people with disabilities to practice sports and the character of the sport as entertainment.

Paralympic sports in the world started to bet more on technology to surpass the limits of athletes with disabilities, helping them to reach the maximum potential in physical, psychological, physiological, social aspects, among others (Almeida et al., 2014). A high-performance athlete needs to have the support of science and technology in the manufacture of high-quality sports equipment and materials, the use of innovative methods for physical conditioning, knowledge in biomechanics to assess limits and body movements to achieve a good result. The technology that aims to assist sports performance can be called Assistive Technology (AT).

According to the Statute for People with Disabilities, the definition of the Assistive Technology is

> Assistive Technology or technical assistance: products, equipment, devices, resources, methodologies, strategies, practices, and services that aim to promote functionality, related to the activity and participation of people with disabilities or reduced mobility, aiming at their autonomy, independence, quality of life and social inclusion (Brasil, 2015b).

Thus, as an example of the contributions of AT in Paralympic sport, according to Ozmen et al. (2014), the wheelchair basketball was a Paralympic sport that has increased worldwide popularity in recent years for people with disabilities and has always had the participation of individuals with spinal cord injury, polio, spina bifida, and amputation.

Burkett (2010) highlights that technology has had a positive influence on Paralympic sports, such as athletics, wheelchair basketball, wheelchair rugby, and wheelchair tennis, especially for using two major key technologies, such as the chair of wheels and prostheses.

However, even with the technology evolution of the adaptation in wheelchairs and other sports equipment, contributing or reducing the harmful consequences to the athlete, these are unprecedented subjects in the research around performance sports (Brazuna & Castro, 2001).

Based on the theoretical reference of AT, authors in Brazil have already identified the Matching Person and Technology (MPT), in which the successful use of AT depends on personal factors (such as support from friends and family, perception of their disability, resilience, expectations with AT, among others); environmental factors (monitoring and support of professionals, site demands, etc.) and factors related to the device (appearance, comfort, safety, effectiveness, demands, expectations reached, etc.) (Alves & Matsukura, 2016; Alves, 2017).

Considering that research on Paralympic sport is still under construction in Brazil, with recent incentive laws and policies, this research aimed to answer the following questions: What are the AT devices that the Paralympians use in Paralympic sport? What is important for the good use of each AT device and the service provided? What are the facilitators and barriers found in the use of AT in para-sports?

Thus, the objective of this research was to present the Assistive Technologies devices used by the athletes, their satisfaction with it and with the service provided, and to

identify the main requirements for the good use of each AT, listing barriers and facilitators for the practice of para-sports.

2 Method

This is cross-sectional exploratory research. According to Gil (2008), descriptive researches are aimed to study the characteristics of a group, to survey the opinions, attitudes, and beliefs of a population. Thus, descriptive research identifies the factors that will determine or contribute to the occurrence of the phenomena. The type of research deepens the knowledge of reality, as it explains the reason and why of the events.

The study was conducted at the Special Physical Education Training Center (Cetefe) in Brasília. It is a large center, a reference in adapted and Paralympic sports in the Midwest region, non-profit, recognized by the Federal and District Public Utility and Social Assistance, and provides free sports services for people with disabilities and their family living in the Federal District. It has more than 350 active sportspeople (adults and teenagers with different types of disabilities) and aims to promote the social inclusion of people with disabilities through sport, with planned, continuous, and free activities.

The inclusion criteria were all adult individuals (from 18 to 45 years old), with physical and/or visual disabilities, already assessed (motor, cognitive and sensory) by the Cetefe coordinator at the time of the para-athletes entry into the Center, and with registered active in the center. Only those who practiced sport in Paralympic sports (high-performance athletes) and who were in the initial and/or intermediate stages of preparation for competitions were included. Para-athletes who use general AT, such as crutches, walkers, or devices that are not specifically used for para-sports were excluded.

All registered athletes who met the criteria were contacted via phone for an invitation to participate in the research, clarifications, and consultation on availability.

Before starting the collection, the objective of the research was explained to each participant, with the subsequent signing of the Free and Informed Consent Form. The collections were made in June and August 2018, before or after the training of each modality, according to the schedule with the researcher.

The instruments used for the collection were:

- *Assistive Technology Device - Predisposition Assessment ATD PA Br* (Alves, 2017): it aimed to assess the expectations achieved with the use of their AT device. For this, the Device form (follow-up version) was applied, with items listed from A to L, scoring the frequency of the event, such as: AT helped to achieve my goals; the device fit my routine; I felt comfortable with the use, among others. The score is from 0 to 5 and given by the AT user, which represents the expectation reached with the AT over its use, in which 0 is "not applicable"; score 1 for "never" (that is, 0% of the time the expectations with AT were reached); score 2 for "sometimes" (approximately 25% of the time expectations with AT were met); score 3 for "half the time" (about 50% of the time); score 4 for "generally" (around 75% of the time); and 5 for "all the time" (100% of the time expectations with AT were reached). Considering the sum of the items A to L, the maximum possible value is 60 points, that is, that AT reached expectations in 100% of the time of use;

- *Quebec User Evaluation of Satisfaction with Assistive Technology - QUEST B* (Carvalho et al., 2014): it aimed to assess the degree of satisfaction of athletes with their Assistive Technology device and the services related to it, experimenting the scale of 1 to 5, in which 1 is dissatisfied; 2 is not very satisfied; 3 is more or less satisfied; 4 is quite satisfied, and 5 is fully satisfied.

This research is part of the project entitled State of Health and Risk of Injury in Para-sports, approved by the Research Ethics Committee of the Faculty of Health of the University of Brasília, Opinion 1,713,534, which contains the authorization of the coordinator of Cetefe.

We chose to analyze each AT device separately, so that the indicators that can contribute to the good use of the device in adapted sports could be presented, based on the perception of the AT user, as described by the MPT (Alves, 2017). Thus, the indicators linked to the device were considered, such as comfort, adjustment, safety, ease of use and those related to personal factors, such as satisfaction with the AT, service provided and expectations reached by the device (Carvalho et al., 2014; Alves & Matsukura, 2016; Alves, 2017). The data were categorized by descriptive statistics, with statistical analysis of absolute and relative frequency.

3 Results

The sample had 54 para-athletes, 46 were male and 6 were female. We observed the following types of disabilities: paraplegia (12), cerebral palsy (08), stroke (06), muscular dystrophy (05), muscular atrophy (05), agenesis of the upper and/or lower limbs (03), brachial plexus injury (03), muscular dystonia (03) and retinitis pigmentosa (03), amputation (02) quadriplegia (02), optic nerve atrophy (02), myelomeningocele (01), Devic´s syndrome (01), sequelae of meningitis and polio (01). The researched modalities were: athletics (2), bocce ball (3), goalball (4), weightlifting (3), swimming (2), para-badminton (8), rugby (12), table tennis (4), indoor tennis (8), archery (4) and sitting volleyball (4).

Among the ATs, 35 (64.81%) were manual wheelchairs, 10 (18.51%) were prostheses, 4 (7.40%) were adapted balls, 2 (3.70%) were orthoses, 1 (1, 85%) was armband, 1 (1.85%) was insole and 1 (1.85%) was adapted racket. Thus, the most common deficiency was paraplegia, the most practiced modality was wheelchair rugby and, consequently, the most used AT was the manual wheelchair.

None of the para-athletes had the support and professional follow-up for their AT device, being under the responsibility of the athletes, friends, and close people (locksmiths, seamstresses, workshop workers, etc.). The Unified Health Service - SUS offered the equipment (wheelchairs, prostheses, and orthoses), with a loan from CETEFE (sports wheelchairs, ball) or by purchasing own demand and income (sports wheelchairs, prostheses, bands, insoles and racket). Both SUS and Cetefe do not offer maintenance and monitoring of the AT device by professionals in the area, or do not offer it on time for the need of the high-performance athlete, considering their competitions and training, or do not offer low-cost AT.

Regarding the *satisfaction with the AT device used in the para-sport*, 43% of the total athletes who used wheelchairs were very satisfied; and 50% of athletes who used prostheses are more or less satisfied. We observed that 100% of the athletes that used

the adapted ball and adapted racket technologies were more or less satisfied, and 100% of the athletes that used the orthosis, armband, and insole were totally satisfied with their Assistive Technology devices.

The services provided for the Assistive Technologies to the athletes did not receive a good evaluation. We observed that 50% or more of the athletes who used technologies such as wheelchair, prosthesis, adapted ball, orthosis, and adapted racket were dissatisfied with the services provided. This item included service, receiving the product, support, among other needs, such as the type of service (professional attitude at the time of sale and when carrying out some support).

The assessment of the AT device proposes that three items should be considered essential to list by the AT user, with the following options: dimensions, weight, fit, safety, durability, ease of use, comfort, effectiveness, delivery, repairs/technical assistance, professional services and follow-up services. In Figures 1 to 5, we characterized the items related to the equipment that the participants considered most relevant.

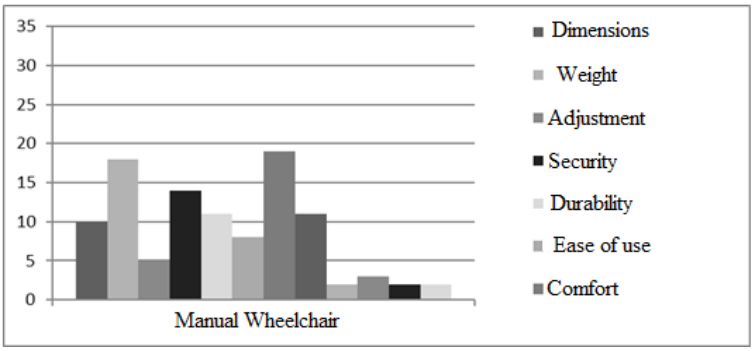

Figure 1. Relevant items for the proper use of the wheelchair (n=35).

Figure 1 shows that, among the 35 participants who used manual wheelchairs, the three components that athletes pointed out as the most relevant ones related to the good use of the wheelchair are: comfort (n = 19, 18%), weight (n = 18, 17%) and security (n = 14, 13%).

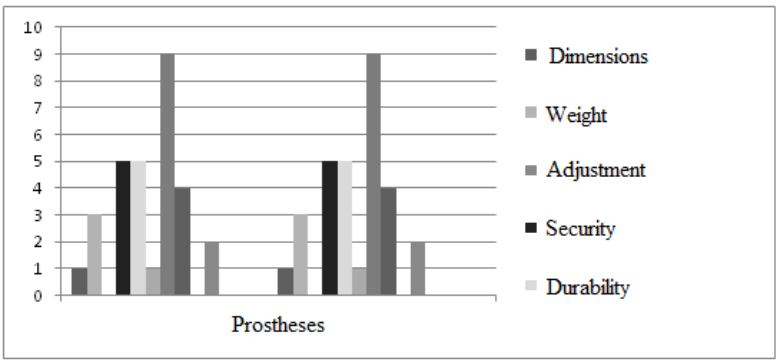

Figure 2. Relevant items for the good use of the prosthesis (n=10).

For athletes who used prostheses, the three most important components related to the good use of the prosthesis were: comfort (n = 9, 75%), safety (n = 5, 42%), and durability (n = 4, 40%).

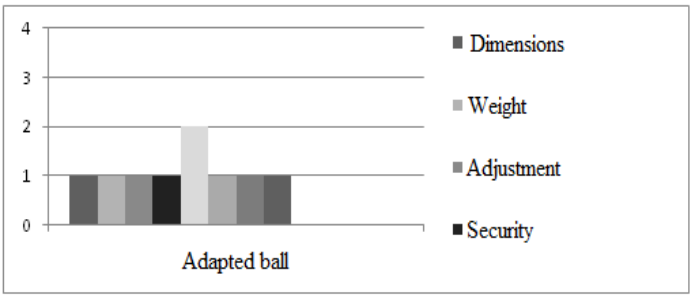

Figure 3. Relevant items for the proper use of the adapted ball (n=4).

Figure 3 shows that the four athletes highlighted the durability (n = 2, 50%) as the most important component for the adapted ball. The items dimension, weight, fit, safety, ease of use, comfort, and effectiveness were tied with one point, and the items delivery, repairs/assistance, professional services, and follow-up services were not chosen by any athlete.

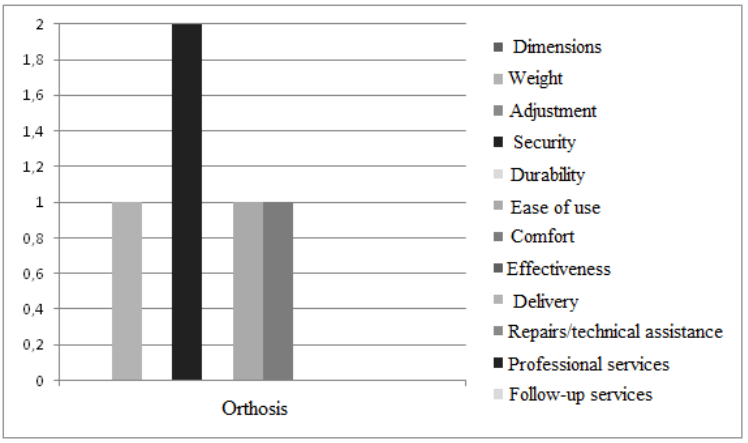

Figure 4. Relevant items for the proper use of the orthosis (n=2).

Figure 4 shows that for the orthosis device, the item safety (n = 2, 100%) was more prominent among athletes. The items of weight, ease of use, and comfort were tied, with one point each.

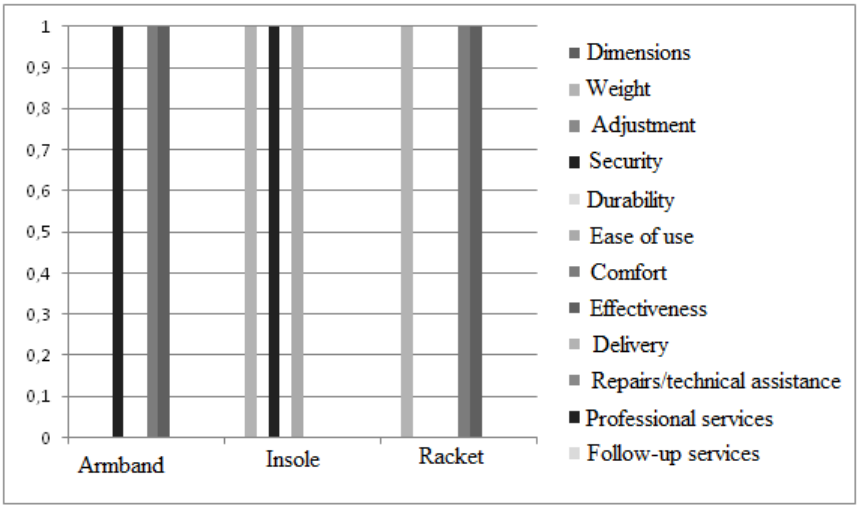

Figure 5. Relevant items for the good use of the armband, insole and racket (n=3).

Figure 5 grouped three different types of AT: armband, insole, and racket. The items identified as most relevant for the armband were: safety, comfort, and effectiveness. We saw that the items indicated for the insole were: weight, safety, and ease of use. And the three most important components related to the racket were: weight, comfort, and effectiveness.

When highlighting the *satisfaction of the athletes*, 43% of the total athletes are quite satisfied; and 50% of athletes who use a prosthesis are more or less satisfied. We also observed that 100% of the athletes who used the adapted ball and adapted racket technologies said they are more or less satisfied and 100% of the athletes who used the orthosis, armband, and insole are totally satisfied with their assistive technology devices.

The *services provided for the assistive technologies* to athletes do not receive good evaluation, and 50% or more of the athletes who used technologies such as wheelchairs, prostheses, adapted ball, orthosis, and adapted racket are dissatisfied with the services provided. This item includes service, product delivery, support among other needs.

Considering the expectations achieved and the use of AT, 67% of the participants showed between 51 and 60 points (expectations reached generally or at all times) and 24% of them had the sum between 41 and 50 points (expectations reached half time or generally), that is, AT has fulfilled its objectives, however, it still needs improvements by the time of use.

4 Discussion

This research was able to present the Assistive Technologies devices used by the athletes, their satisfaction with them and with the service provided, as well as identifying the main requirements for the good use of each AT, listing the possibilities of barriers and facilitators for the practice of para-sports.

Among the studied population, there was a wide range of types of disabilities, types of Paralympic sports, and types of AT. However, there is still greater participation of male athletes. The data could show that, as reported by Almeida et al. (2014),

investments in training and preparation of athletes with disabilities are already on the agenda; however, more investments and incentives from public policies and research in the area are needed.

Paralympic sport is permeated by countless ATs, and many of them are mandatorily present, such as the use of devices and the adapted rules. As pointed out in its definition, ATs are not only equipment and devices, but also products, resources, methodologies, strategies, practices, and services (Brasil, 2015a). However, we identified that the equipment was the only AT cited by the athletes. The wheelchair and prostheses stood out among all the ATs. This data can show are most aware or needed technologies by the athletes. Thus, Almeida et al. (2014) and Burkett (2010) already reinforced that one of the main objectives of science and technology in sport has been the way of handling athletes related to wheelchairs and prostheses, mainly to improve their performance and because they are both key technologies in most Paralympic sports.

However, as they are the most cited technologies and it is a high-performance sport, there should supposedly be more research involved, which is not the case.

In a systematic review study, Marques (2017) sought to find evidence about the use of AT devices in adapted and Paralympic sports. We found 26 articles and only one study evaluated the effectiveness of AT in adapted sports; the other studies highlighted the incidence of injuries in Paralympic sport and performance without associating the use of the technology. As in this study, the wheelchair was predominant in 22 of the selected articles.

When thinking about other types of ATs used in para-sports, without such prominence among the participants and in the literature, it is worth asking about the real access that people with disabilities are having in the concepts of ATs, their policies, and rights.

In Brazil, there are public policies aimed specifically at the devices through the AT granting law 13.14, 2015, with an addition to the Law Project 6,950, of 2017, offering wheelchairs and prostheses but not specific to the sport. We can also mention the government financing in investment notices in Innovations and Research (Brasil, 2015a). However, we can think about the interest of researchers and private companies in investments only in high-cost ATs, as it brings considerable financial return and prominence.

There are policies in Brazil to support the para-athletes that will find actions at municipal, state, and federal levels such as the sports incentive grants, the Angelo/Piva Sports Incentive Law and the Athlete Grant (Reis et al., 2017). However, even with these possibilities, we question whether these policies are sufficient and whether they reach the real interested parties, the disabled who want to play sports. Thus, researchers and professionals in the area have the role of disseminating studies, presenting results on the real needs of AT users in para-sports, to improve innovation studies, access to AT, and public policies.

Considering the satisfaction of the athletes with AT, we noted that there are different levels of satisfaction regarding the use of AT in para-sports. Among the dissatisfied individuals and the more or less satisfied, approximately 60% of the interviewed athletes indicated the wheelchair, and 80% indicated the prosthesis. Since the 1980s, researchers have already presented some determining factors for the satisfaction variable (Alves & Matsukura, 2016; Alves, 2017; Scherer & Sax, 2010). The authors reported that ATs

can appear to be perfect, focusing on a specific need, but it can be ineffective when personal criteria, social characteristics, or environmental needs are not considered, generating personal frustration, abandonment, and, consequently, excessive financial resource expenditure. Carvalho et al. (2014) cited in their research that the relationship between satisfaction and the use of Assistive Technology is considered multidimensional, as it is influenced by expectations, perceptions, attitudes, and personal values.

Alves & Matsukura (2016) pointed out that the individual's psychosocial factors influence the person's desire and the ability for the use of ATs and, therefore, these components must be considered when assessing and selecting AT, to minimize frustrations, dissatisfaction, and abandonment of the device.

The satisfaction of Paralympic athletes with the services provided by most of the assessed ATs had 50% or more of the athletes dissatisfied with the maintenance of their AT. This finding may reinforce the need for AT services that not also indicate and make devices available but can continuously monitor their use and adjustment needs, including sports ATs, considering their specificities and time for use. Observing the demand and the lack of trained service, the AT user often takes the initiative to adjust or develop his device, and may not be the best option. Therefore, the need for investments in services and the training of professionals and that they consider the fundamentals of good use of AT as the personal, environmental, and device factors are identified (Alves, 2017; Carvalho et al., 2014; Scherer & Sax, 2010). The MPT conceptual model points out that AT professionals should consider: the needs of AT users, their goals and preferences; the personal, social and environmental barriers that can affect the use of ideal technology; the training perspective to achieve optimal utilization; and the possibility of additional supports that can increase the usability of the device (Alves, 2017).

Considering the requirements that para-athletes deemed relevant to the proper use of their device, the weight, safety, and comfort were highlighted for the wheelchair. In a survey of people with disabilities who use ATs and specifically wheelchairs, Renner et al. (2018) highlighted the concern related to the physical structure of the wheelchair since most of them are still quite ineffective in the requirements that provide comfort, and this condition of well-being is mainly related to such a structure, both by sensation and by the process of social inclusion/exclusion.

The most cited components seen as essential by the para-athletes who use the prosthesis were: comfort, safety, and durability. Rodrigues et al. (2016) mentioned in their study that prostheses, in an international context, were assembled based on guidelines provided by their manuals, and to obtain safety information many users can access websites of some brands. Rodrigues et al. (2016) also mentioned that, in terms of comfort, the study cannot analyze this perception since it is subjective. However, the authors analyzed that the prostheses allowed adjustments to their interfaces, which could influence the user's discomfort. However, Resnik et al. (2012) considered in their research on prostheses that human factors together with ergonomics are indispensable. They also pointed out that the individual's access to prostheses should be considered for the financial capacity and practices of the health system of the country where the user lives that according to WHO, 80% of people with some type of physical disability live

in low-income countries, which means that they have restricted access to prostheses due to their high cost (Resnik et al., 2012).

As for the adapted ball, the athletes chose the following items as essential components: durability, dimension, weight, fit, safety, ease of use, comfort and effectiveness; and for the orthosis, the para-athletes pointed out as essential components: safety, weight, ease of use and comfort. Roncantto's study (2017) showed that the interaction between design and health is very lacking when designing an assistive project and that the design intervention related to AT devices is still very limited. As a result, the technologies currently available for the development of orthoses are quite handmade, which implies discomfort, lack of precision, delay in making, limited costs, and time to obtain the orthosis.

Considering the armband, insole, and racket, the components reported as the most relevant were: safety, comfort, and effectiveness. We can see that the components indicated for the insole were: weight, safety, and ease of use. Finally, the three most important components related to the adapted racket were: weight, comfort, and efficiency. We noticed that the essential for each para-athlete and modality would be a technology that addresses their different needs.

The low satisfaction data with the technology devices and the services provided together with the expectations reached in 67% of the cases showed that there are still needs to be addressed in the area. We understood that the items indicated by the athletes as relevant requirements for the good use of AT and the service can be considered as barriers and facilitators. They are facilitators when they are considered by the professional in conjunction with the AT user at the time of assessment, prescription, and monitoring, and start to assist the individual's participation in their activity. However, the same components mentioned, such as comfort, safety, ease of use, or monitoring the service can be a barrier when they are not considered and effective to the individual's performance in the activity (Marques, 2017). Additionally, the relevance of evaluating, prescribing, monitoring the use of Assistive Technology devices with the target population, that is, in the face of a user-centered approach, is a major step towards improving their satisfaction and, consequently, of its performance in sports activities, which has been discussed in the international literature for AT in general and, more recently, in Brazil (Scherer & Sax, 2010; Carvalho et al., 2014; Alves & Matsukura, 2016; Alves, 2017; Roncatto et al., 2017).

For the occupational therapy, Ferreira et al. (2017) described that for the handball para-athletes, the participation of a team of professionals involved in this practice was necessarily highlighting the importance of multidisciplinary work, encompassing physical educators, physiotherapists, and occupational therapists because the combination of these professionals allows several possibilities for team actions to the individual with disabilities.

Recently, the Federal Council of Physiotherapy and Occupational Therapy (COFFITO) published Resolution 495/2017, which validates the practice of the occupational therapist with sport and para-sports (Brasil, 2017). This resolution considers the following functions of the occupational therapist with this people: to prescribe, guide, execute and develop products, resources, methodologies, strategies, practices, and services of assistive technology to improve the performance of athletes and para-athletes with disabilities, assisting the development of Daily and Instrumental Life

Activities, favoring social participation and quality of life. It also determines that interdisciplinary actions are conducted in sports training programs for injury prevention and performance optimization, using assistive technology in different performance areas, helping the best performance of the athlete in sports (Brasil, 2017). Thus, this study can bring possibilities for reflections and actions by the occupational therapist in the emerging area of para-sports.

5 Conclusion

This research achieved its objectives by identifying, in the Assistive Technologies used in Paralympic sport, the satisfaction of the athletes with their devices and services provided, and the relevant requirements for the device, variables that are directly related to the good use of the AT. In this way, some factors can act as facilitators and/or barriers.

This paper systematized subjective information based on specific research instruments on the use of ATs and contributed to the understanding of the perception of the Paralympic athlete and factors that must be considered based on the user's reports.

It was difficult to find studies on Assistive Technologies within Paralympic sport. Thus, this study can collaborate for the construction of knowledge in the area of AT and for occupational therapists who work and research in the area, in addition to acting as a triggering study for new topics.

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References

Almeida, J. J. G., Miranda, T. J., Storch, J. A., Harnisch, G. S., & Bredariol, B. (2014). Esporte paralímpico: simbiose entre ciência e tecnologia? *ComCiência*, (157), 1-3.

Alves, A. C. J. (2017). *Avaliação de Tecnologia Assistiva: predisposição ao uso ATD PA Br: versão brasileira.* Brasília: Editora Universidade de Brasília.

Alves, A. C. J., & Matsukura, T. S. (2016). Modelos teóricos para indicação e implementação de Tecnologia Assistiva. *Cadernos de Terapia Ocupacional da UFSCar*, *24*(3), 591-599. http://dx.doi.org/10.4322/0104-4931.ctoAO1078.

Brasil. (2015a, 6 de julho). Lei nº 13.146, de 6 de julho de 2015. Institui a Lei Brasileira de Inclusão da Pessoa com Deficiência (Estatuto da Pessoa com Deficiência). *Diário Oficial [da] República Federativa do Brasil*, Brasília.

Brasil. Senado Federal. (2015b). *Estatuto da pessoa com deficiência*. Brasília: Coordenação de Edições Técnicas.

Brasil. Conselho Federal de Fisioterapia e Terapia Ocupacional – COFFITO. (2017, 11 de julho). Resolução nº 495, de 18 de dezembro de 2017. Disciplina a atuação profissional da terapia ocupacional no desporto e paradesporto e dá outras providências. *Diário Oficial [da] República Federativa do Brasil*, Brasília. Recuperado em 30 de junho de 2019, de https://www.coffito.gov.br/nsite/?p=8781

Brazuna, M. R., & Castro, E. M. (2001). A trajetória do atleta portador de deficiência física no esporte adaptado de rendimento: uma revisão da literatura. *Motriz*, *7*(2), 115-123.

Burkett, B. (2010). Technology in Paralympic sport: performance enhancement or essential for performance? *British Journal of Sports Medicine*, *44*(3), 215-220. PMid:20231602. http://dx.doi.org/10.1136/bjsm.2009.067249.

Carvalho, K. E. C., Gois Júnior, M. B., & Sá, K. N. (2014). Tradução e validação do Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2.0) para o idioma português do Brasil. *Revista Brasileira de Reumatologia*, *54*(4), 260-267. PMid:25627220. http://dx.doi.org/10.1016/j.rbr.2014.04.003.

Corrales, C. M. S., & Castro, E. D. (2016). *Passear e participar: o lazer ampliando a circulação social de pessoas com deficiência.* Belo Horizonte: Licere.

Costa, A. M., & Souza, S. B. (2004). Educação física e esporte adaptado: história, avanços e retrocessos em relação aos princípios da integração/inclusão e perspectivas para o século XXI. *Revista Brasileira de Ciências do Esporte*, *25*(3), 27-42.

Ferreira, N. R., Carrijo, D. C. M., Silva, E. S., Ramos, M. C., & Carneiro, C. L. (2017). Contribuições do esporte adaptado: reflexões da terapia ocupacional para a área da saúde. *Revista Interinstitucional Brasileira de Terapia Ocupacional*, *1*(1), 52-66.

Gil, A. C. (2008). *Como elaborar projetos de pesquisa.* São Paulo: Atlas.

Marques, M. P. (2017). *Caracterização dos fatores ambientais no paraesporte segundo o raciocínio clínico da CIF: a tecnologia assistiva, fatores pessoais, sociais e desempenho.* Brasília: Universidade de Brasília.

Ozmen, T., Yuktasir, B., Yildirim, N. U., Yalcin, B., & Willems, M. E. T. (2014). Explosive strength training improves speed and agility in wheelchair basketball athletes. *Revista Brasileira de Medicina do Esporte*, *20*(2), 97-100. http://dx.doi.org/10.1590/1517-86922014200201568.

Reis, R. E., Mezzadri, F. M., & Silva, M. M. (2017). As políticas públicas para o esporte paralímpico no Brasil: apontamentos gerais. *Revista Corpoconsciência*, *21*(1), 58-69.

Renner, J. S., Barth, M., Haubert, B., & Nascimento, B. P. (2018). Tecnologias Assistivas e cadeira de rodas infantil: uma discussão com enfoque para o conforto, os aspectos lúdicos e a inclusão social. *Revista Observatório*, *4*(3), 156-179. http://dx.doi.org/10.20873/uft.2447-4266.2018v4n3p156.

Resnik, L., Meucci, M. R., Lieberman-Klinger, S., Fantini, C., Kelty, D. L., Disla, R., & Sasson, N. (2012). Advanced upper limb prosthetic devices: implications for upper limb prosthetic rehabilitation. *Archives of Physical Medicine and Rehabilitation*, *93*(4), 710-717. PMid:22464092. http://dx.doi.org/10.1016/j.apmr.2011.11.010.

Rodrigues, R. S., Cinelli, M. J., Ferreira, M. G. G., & Domenech, S. C. (2016). O design de próteses open source para membros superiores por meio da análise documental de projetos. *LOGO e-Revista*, *5*(2), 93-119. http://dx.doi.org/10.26771/e-Revista.LOGO/2016.2.06.

Roncatto, S. C., Serpi, B. S. T., Guimarães, G. M. B., Merino, G. S. A. D., & Merino, E. A. D. (2017). Projeto de órteses: definição de requisitos com base no usuário, produto e contexto de uso. *Revista Ação Ergonômica*, *12*(2), 8-14.

Scherer, M. J., & Sax, C. L. (2010). Measures of assistive technology predisposition and use. In E. Mpofu & T. Oakland (Eds.), *Rehabilitation and health assessment: applying ICF guidelines* (pp. 229-254). Nova York: Springer Publishing Company.

Silva, A. A. C., Marques, R. F. R., Pena, L. G. S., Molchansky, S., Borges, M., Campos, L. F. C. C., Araújo, P. F., Borin, J. P., & Gorla, J. I. (2013). Esporte adaptado: abordagem sobre os fatores que influenciam a prática do esporte coletivo em cadeira de rodas. *Revista Brasileira de Educação Física e Esporte*, *27*(4), 679-687. http://dx.doi.org/10.1590/S1807-55092013005000010.

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Ana Cristina de Jesus Alves contributed to the preparation of the text, data collection, analysis of results, organization of research sources, text review. Isabel Cristinna do Nascimento da Silva contributed to the research design, text writing, reviews, data analysis, text review. All authors approved the final version of the text.

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